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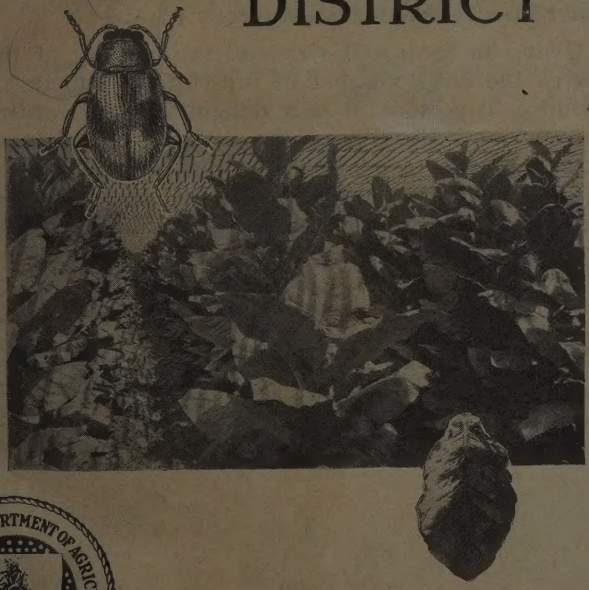
The TOBACCO FLEA-BEETLE IN THE SOUTHERN CIGAR-WRAPPER DISTRICT



THE tobacco "flea" or flea-beetle is an important insect pest in the southern cigar-wrapper district (northern Florida and southern Georgia). Under normal weather conditions, with careful utilization of control measures, the damage caused by this insect is usually small. It is only necessary, however, for the right conditions to arise, with neglect of control measures, to bring the damage up to alarming proportions. Because of this ever-present menace, the tobacco flea-beetle has probably caused more apprehension among tobacco growers than any other insect pest of this district.

Owing to the small size and the activity of this insect, the large number of individuals, and its resistance to poisons, it is a difficult pest to control. No one method will give the desired control in all cases. It is believed, however, that a knowledge of the insect's habits, together with the combination of control measures given in this bulletin, will enable the progressive tobacco grower to reduce the flea-beetle damage to a low point.

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THE TOBACCO FLEA-BEETLE[1] IN THE SOUTHERN CIGAR-WRAPPER DISTRICT.

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CHARACTER OF INJURY AND EXTENT OF LOSSES DUE TO THE TOBACCO FLEA-BEETLE.

FLEA-BEETLES injure tobacco by eating small irregular holes in the leaves (Fig. 1). In unshaded fields, the beetles confine their feeding to a considerable extent to the lower part of the plant, but under shade conditions feeding is done generally over the entire plant. In some cases even the bud leaves are damaged. As the hole is often made before the leaf has completed its growth, the size of the hole increases as the leaf grows, and the damage is accordingly increased.

As the tobacco grown in this district (northern Florida and southern Georgia) is of the cigar-wrapper type, even a few of these feeding punctures detract greatly from its value. Injury to a leaf used as a wrapper means much more than to a leaf which is to be used as binder, filler, or for other purposes. Shade-grown wrapper tobacco is sold for a higher price than any other tobacco in this country, and the losses from flea-beetle damage are proportionately great.

The damage to an individual crop may vary from very little to practically a total loss. In 1918, when the flea-beetle infestation in certain sections was unusually severe, the average damage sustained by the tobacco crop in one county was estimated at $250 per acre, or approximately 15 per cent of its value. In other seasons only a small proportion of the crop may be damaged to any appreciable extent. Late or second crops of tobacco, now almost entirely discontinued, invariably suffer much more from flea-beetle injury than tobacco set out at the usual time.

[1] *Epitrix parvula* Fab.; order Coleoptera, family Chrysomelidae.

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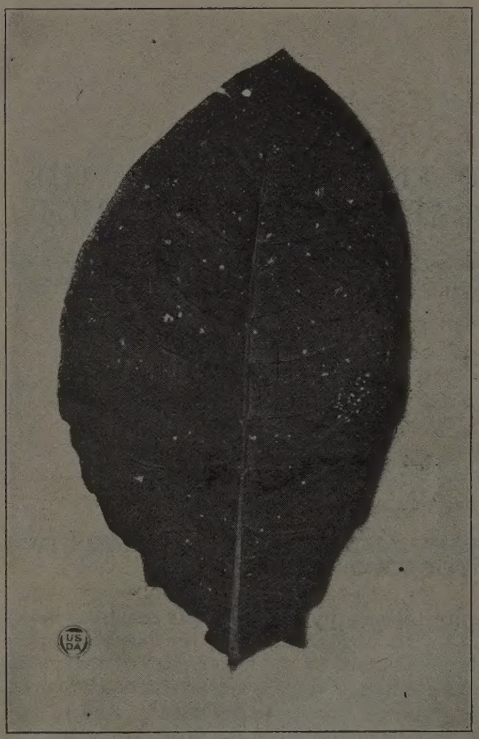

FIG. 1.—Tobacco leaf showing flea-beetle injury.

DISTRIBUTION.

The tobacco flea-beetle is widely distributed in North America, occurring to a certain extent wherever tobacco is grown. It has also been recorded from Porto Rico, Cuba, the Bahama Islands, Panama, Hawaii, the Philippines, Ceylon, and portions of South America.

LIFE HISTORY AND DESCRIPTION OF STAGES.

LIFE CYCLE.

In its life cycle the tobacco flea-beetle passes through four distinct stages, namely, the egg, the larva, the pupa or resting stage, and the adult, which is a beetle. It is only in this last stage that this flea-beetle is known to the tobacco growers, the other three stages being rarely if ever seen.

THE EGG.

The tiny egg (Fig. 2), which is about one-sixtieth of an inch long, is oval and pearly white. In the spring incubation takes about 11 days, but later in the summer the eggs usually hatch in about 5 days.

FIG. 2.—Eggs of the tobacco flea-beetle. Twenty-five times natural size.

THE LARVA.

The egg hatches into a tiny, dirty white worm, or larva

Fig. 3), about one-thirtieth of an inch long. This worm begins feeding immediately, and grows rather fast, finally attaining the length of approximately three-sixteenths of an inch (Fig. 4). During this period of growth the larva sheds its skin three times. A few days before shedding its skin for the third time, however, the worm hollows out a small oval-shaped cell just below the surface of the soil, and enters a quiescent or non-feeding period, which lasts from 3 to 6 days.

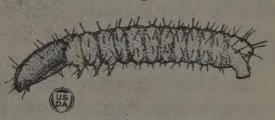

FIG. 3.—Newly-hatched larva of the tobacco flea-beetle. Greatly enlarged.

During the cool weather of early spring, the entire larval period lasts about 29 days, but in the hot weather of midsummer this time is shortened by nearly one-half.

FIG. 4.—Mature larva of the tobacco flea-beetle. Greatly enlarged.

THE PUPA.

When the larva sheds its skin for the last time, the whitish pupa appears (Fig. 5). In this stage the insect more nearly resembles the adult form, the legs, antennæ, and wings being plainly seen folded under or about the body. The insect remains in its cell during the pupal period, neither eating nor engaging in any other activity. In the spring this stage usually requires about 7½ days, but in the summer it may be reduced to 4½ days. The pupa then changes to the adult, or beetle.

FIG. 5.—Pupa of the tobacco flea-beetle. Greatly enlarged.

THE ADULT.

FIG. 6.—Tobacco flea-beetle. Adult. Greatly enlarged.

The adult of the tobacco flea-beetle (Fig. 6) is rather small, measuring only about one-sixteenth of an inch in length. It is dark brown, with two darker-colored areas of rather indefinite size and shape on the wing covers. The name "flea" or "flea-beetle" is derived from the fact that it can hop like a true flea, the hind legs being much larger and stronger than the others. This hopping habit is so noticeable that it is one of the easiest means of identifying the insect.

SEASONAL HISTORY AND HABITS.

The tobacco flea-beetle passes the winter in the adult form. The beetles are usually first noticed early in the spring when the tobacco plants are beginning to appear in the seed beds. They come from their winter fast with ravenous appetites and seek food immediately.

In their search for food, the beetles not only hop but fly. Although this fact is not well known, the beetles frequently fly for a considerable distance. Seed beds have been known to have become infested when located in the heart of heavy timber at least a mile from any point where tobacco had previously been grown. Once the beetle finds tobacco and begins feeding, however, there seems to be little further movement unless due to disturbance.

The first beetles to issue from hibernation in the spring begin laying eggs in the seed beds while the plants are still small. The moist, sheltered beds furnish excellent breeding places, and often produce large numbers of this insect. No doubt it frequently happens that the larvæ, which feed on the roots, are carried on the plants from the seed bed to the field.

By the time plants are being set in the fields, egg deposition is well under way. The average overwintering female is capable of depositing approximately 200 eggs. At this season most of the eggs are deposited in the soil near the base of the stalk, many apparently being placed in the moist depression where the plant was watered at setting time. Later in the season the eggs evidently are deposited in the soil beneath the lower leaves which rest on the ground.

The larvæ, or tiny worms, which hatch from the eggs burrow into the soil and feed on the tobacco roots. The newly-hatched larvæ frequently tunnel the rootlets, and in some cases the small roots are girdled. Where the larvæ occur in large numbers, their feeding must necessarily weaken the plants considerably. Just how much damage results from this has never been determined. It is not improbable, however, that many cases of stunting and slow growing off, now attributed to various other causes, could be traced to the feeding of the flea-beetle larvæ.

Preparatory to entering the pupal state, the larva forms a cell, and in this cell the beetle later remains for from 12 to 24 hours after becoming adult. The newly-transformed beetle is grayish white and the body covering is still soft. The covering soon begins to harden, however, and to assume its characteristic dark-brown color. The beetle then emerges from the soil and begins feeding.

The adult progeny of the hibernated flea-beetles in northern Florida and southern Georgia usually begin to appear from the 1st to the middle of May. The majority of them may appear at about the same time or they may continue to emerge over a considerable period. Large numbers often emerge after showers, when the upper soil is soft enough to allow free access to the surface.

For several days after emergence the young beetles can easily be distinguished from those of the next preceding or overwintered generation by the fact that they are lighter and brighter in color, and smaller in size. They also confine their feeding to the under surfaces of the lower leaves, where they find protection and concealment. In most of this early feeding the punctures seldom go clear through the leaf.

The beetles remain on the lower leaves for three or four days and then gradually spread over the entire plant. Under shade conditions there seems to be very little choice between the upper and lower surfaces of the leaves, although in high tobacco there is apparently some slight preference for the upper surface.

After a feeding period of about three weeks these beetles begin laying eggs. The incubation of the eggs and subsequent development of the larvæ are similar to those of the first spring brood, but are accomplished in a much shorter time. Although the first spring brood usually requires about 48½ days for its development from egg to adult, this second brood usually develops in about 24½ days. The second spring brood, or first summer brood, usually appears about the time tobacco has reached maturity, and frequently does much damage.

From this it is seen that the tobacco crop is attacked by the overwintered brood and two later broods of flea-beetles. After the crop is harvested there may be additional generations which so overlap that it is impossible to tell them apart. If favored by natural conditions, each brood brings about an enormous increase of individuals. For this reason late or second crops of tobacco are often destroyed in spite of control measures.

During the late summer months the beetles become very scarce. Few eggs are deposited and still fewer young survive. A large number of the adults apparently die off and the remainder show little activity.

With the coming of cold weather the beetles seek shelter under piles of leaves, weeds, trash, or any sort of material which affords protection. There they remain in a more or less dormant condition during the winter. In warm periods, however, the beetles become more active and may often be found feeding in sheltered spots.

FOOD PLANTS.

Although tobacco is the preferred food plant of the tobacco flea-beetle, numerous other wild and cultivated plants belonging to the same family (Solanaceae) are fed upon to a considerable extent. Among these the most important are ground cherry, common nightshade, horse nettle, jimson weed, tomato, potato, eggplant, and pepper plant. In the absence of solanaceous plants the beetles will feed sparingly upon various other wild and cultivated plants.

NATURAL ENEMIES.

Unfortunately, the tobacco flea-beetle is not preyed upon by natural enemies to any great extent. One of its rather important enemies is a large green spider [2] very commonly found on tobacco plants. A small black and white insect,[3] having a beak, is sometimes also found attacking the flea-beetle. Wild birds of several species prey upon it to a certain extent, those of most importance being the swallows, the warblers, and the ruby-crowned kinglet.

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[2] *Peucetia viridans* Hentz. [3] *Geocoris punctipes* Say.

CONTROL MEASURES.

Tobacco flea-beetles are very resistant to and are only slightly repelled by common insecticides, and their control by these alone is not an easy matter. For this reason every possible means should be utilized to keep them continually subdued. This applies especially to the southern cigar-wrapper district, where only a small number of beetles to the stalk constitutes a serious infestation.

All the methods of control, both direct and indirect, suggested in this bulletin should receive serious consideration, for they all have an important bearing on the problem. The indirect means of control, while of vital importance equally with the direct, are not as fully appreciated by the tobacco grower. These indirect methods necessitate only a small expenditure of time and money, and they serve to reduce the numbers of several other tobacco insect pests as well as the tobacco flea-beetle.

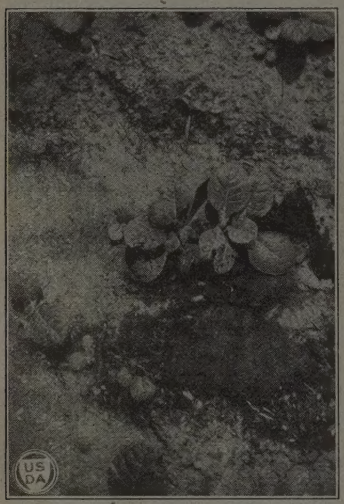

FIG. 7.—Young tobacco plants on bed, showing flea-beetle injury.

LOCATION OF PLANT BEDS.

Plant beds should be located as far as possible from tobacco fields. Much trouble from flea-beetles can often be avoided by this means alone. The moist soil under the plants in the bed, which is not disturbed except by weeding, furnishes an excellent breeding place for the next generation of beetles. A very slight infestation of a bed by overwintered beetles can often produce a surprisingly large number of the next brood, which will invariably attack the tobacco in any near-by shade or field. If the bed is located at some distance this danger is considerably lessened.

CONTROL OF FLEA-BEETLES ON PLANT BEDS.

While tobacco flea-beetles seldom cause severe damage in the plant beds of this region, the beds should be protected from their attacks as much as is possible, whether the beds are near the tobacco fields or not. This should be done not only to protect the young plants against such injury as is shown in Figure 7, but also to reduce the numbers of the succeeding generation, which may fly to the fields or be carried there on the plants.

Frequent light applications of powdered arsenate of lead to the young plants usually give fairly good protection. If applications are made while the plants are dry the danger from burning is but slight.

The coarse cheesecloth used over the plant beds of this region also gives a certain amount of protection against flea-beetle attack.

FREQUENT AND THOROUGH CULTIVATION.

As frequent and thorough cultivation of the tobacco crop is practiced to a pronounced extent in this section, there is little need to recommend anything in this respect. It may be stated, however, that frequent cultivation of the top soil unquestionably destroys a considerable number of the younger stages of the flea-beetle.

DESTRUCTION OF WEEDS IN AND AROUND TOBACCO FIELDS.

The tobacco flee-beetle not only feeds upon but it also multiplies upon a number of wild plants. For this reason, all weeds in and

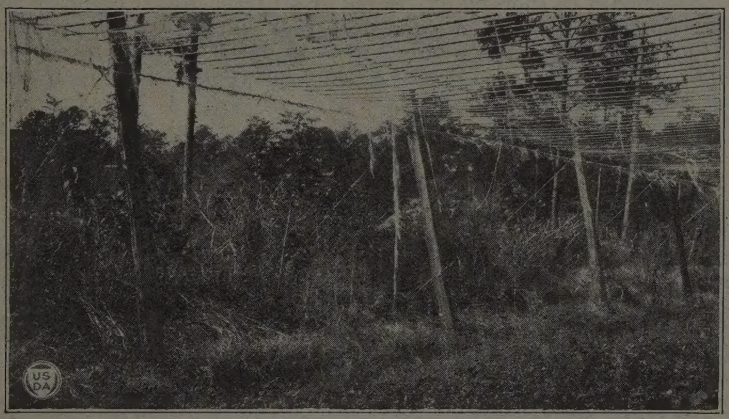

FIG. 8.—Border of tobacco shade, showing material under which beetles hibernate.

around the edges of tobacco fields should be destroyed as far as practicable. (See Fig. 8.) This applies especially during the early spring before transplanting time, and during the growing season.

On all tobacco land a heavy growth of weeds springs up after the crop has been harvested. Clean cultivation at this season—during the summer and early fall—is not usually considered advisable, as such a practice in this region greatly impoverishes the soil and necessitates a large expenditure for labor. The planting of certain field and cover crops, however, avoids these difficulties and assists greatly in keeping down the weeds.

DESTRUCTION OF TOBACCO STALKS AFTER HARVESTING.

Another important indirect method of controlling the tobacco flea-beetle is the destruction of all tobacco stalks immediately after the crop has been harvested by cutting them down and plowing under both stumps and stalks. The removal of their food supply at this time prevents the continued breeding of the beetles, and of many other tobacco insect pests as well.

DESTRUCTION OF FLEA-BEETLES IN HIBERNATION.

The tobacco flea-beetle lives over the winter in the adult stage in protected places in and around tobacco fields. The great majority apparently hibernate very close to the shades when protective material is available. Beetles have been taken in piles of dead leaves, weeds, pine needles, and practically everything which would afford protection in cold weather. The burning of such material during the winter undoubtedly destroys many of the hibernating beetles. Where a tobacco shade is bordered by ditch banks, fence rows, etc., it is a good plan to burn as wide a strip as possible all around the field. Care should be taken to select a cold day when the beetles are inactive, and when there is enough wind to cause a good, sweeping fire.

With the coming of cool weather in the fall, the interiors of shades should be thoroughly cleared of all trash which might harbor overwintering beetles. A good deep plowing at this season is also of much benefit. It not only serves to cover up dead weeds and other débris, but it also destroys many hornworms and other insect pests overwintering in the soil.

APPLICATIONS OF POISONS IN THE FIELDS.

Flea-beetles are very resistant to poisons, and as heavy applications of insecticides may do much damage to cigar-wrapper tobacco during the latter part of the growing season, efforts should be made to control this pest during the early part of the season. The overwintered beetles which attack the newly set plants are comparatively few, and the damage which results from their feeding in most instances is very slight. They do, however, deposit a large number of eggs which develop into another brood. This generation and the second which may follow if favored by natural conditions are the broods which seriously injure the tobacco crop. For this reason the overwintered individuals should be controlled as quickly as possible when they attack newly set tobacco. To accomplish this end, a quick-acting poison should be applied soon after setting.

Up to the present time the most satisfactory results in controlling tobacco flea-beetles on young plants have been obtained by frequent light applications of Paris green in the dust form. The prevailing custom in this region is to use this material undiluted, but in some cases it is successfully used when mixed with a carrier. After the plants have taken root, which is usually about three days after setting, two applications a week of three-fourths to 1½ pounds of Paris green per acre seldom cause any damage to the foliage. In some cases heavier applications are apparently safe, but under normal conditions they are not to be recommended. If the plants are weakened by dry weather or by disease, burning is much more likely to occur. A slight burning of the foliage at this time, however, does little damage, as none of the lower leaves are sent to the packing house. Severe burning, on the other hand, may stunt or even kill a portion of the stand.

Heavy applications of arsenate of lead may be used on young tobacco plants with comparative safety. Unfortunately, the action of this poison on the tobacco flea-beetle is much slower than that of Paris green. Certain other poisons or poison mixtures may also be

used at this time, but usually with much less satisfactory results than when frequent, light applications of Paris green are used.

A heavy infestation of beetles of the first spring generation, which usually appears when tobacco is about knee-high, or the one which may follow during the latter part of the season, is very difficult to control. No material has yet been found which will kill the flea-beetles at once without serious injury to the tobacco foliage. Even the common arsenicals must be used with extreme caution, or the damage caused by them may exceed that done by the beetles. Repellents, such as tobacco dust or sulphur, usually afford but slight protection. Arsenate of lead frequently causes a more or less permanent whitening or "painting" of the leaves, which greatly detracts from their value. Good grades of calcium arsenate, when used at the rate of from 4 to 6 pounds per acre, either alone or with equal weights of tobacco dust as a carrier, have given a fair degree of control in most experiments, and usually with very little injury to the plant. On the other hand, some grades of calcium arsenate have caused serious injury to the tobacco plant. Because of the variability in composition and action of this material, the writers do not recommend its use, although it ranks next to Paris green in insecticidal action. Many other materials have been tested, but none has given as satisfactory results as Paris green.

Although the use of Paris green has marked disadvantages, this material now appears to be the most satisfactory insecticide for use on high tobacco of the cigar-wrapper type. The main objection to the use of this poison on tobacco foliage is its tendency toward burning, which may vary greatly with the weather conditions. Growers accustomed to its use, however, usually succeed in applying it with but slight injury to the foliage. Frequent light applications (three fourths to 1 pound per acre two or three times a week) produce the best results. At this season Paris green is the poison mainly used in controlling the tobacco hornworms, and the same applications also serve in checking the attacks of the flea-beetles.

When the young beetles are emerging from the soil under the plants light applications of this poison directed toward the lowest leaves are extremely effective. The flea-beetles are least resistant to the action of poisons at this stage of development, and the infestation may be checked before the higher and more valuable leaves are reached.

SUMMARY OF CONTROL MEASURES.

Locate plant beds at some distance from tobacco fields.

Protect plant beds from the attacks of beetles.

Practice frequent and thorough cultivation of the tobacco crop.

Destroy weeds in and around tobacco fields.

Destroy tobacco stalks immediately after harvesting the crop.

Destroy beetles during cold weather by burning over hibernation places.

In the spring, if tobacco is attacked in the fields by overwintered beetles, control as quickly as possible by frequent applications of poison. Light applications of Paris green give best results. Paris green may also be used to check the heavier infestations by later broods.

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